WALSH

REPORT

ON

PROJECT

OF THE

United Comstock Pumping Association

FOR

Unwatering the North Comstock Mines

ANSWERING FORTY-SEVEN QUESTIONS

OF

MR. WHITMAN SYMMES

A. M. WALSH,
Supt. U. C. Pumping Association

— TO —

WHITMAN SYMMES,
Supt. Mexican Mine

VIRGINIA CITY, NEV.
October 29, 1913

PRESS OF
UPTON BROS.
& DELZELLE

Recently the Mexican Gold and Silver Mining Company, at a meeting of its Board of Directors, called for the purpose of considering the resumption of its payments to the United Comstock Pumping Association, instructed Mr. Whitman Symmes, its Superintendent, to examine the pumping plant of the United Comstock Pumping Association, and to report upon it, and also upon the proposed project for further lowering the water to the 2,700-foot level with the Starrett Pumps, and upon the conduct of our operations since Mr. A. M. Walsh succeeded Mr. Symmes as Superintendent of the Pumping Association.

Mr. Symmes accordingly addressed forty-seven questions to Mr. Walsh, which are fully answered by Mr. Walsh in the following report. The answers made present the pumping situation upon the Comstock Lode so clearly that the Pumping Association has published them for the information of the stockholders of the constituent companies.

UNITED COMSTOCK PUMPING ASSOCIATION,

By A. WATERMAN, Secretary.

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SUPERINTENDENT'S OFFICE

UNITED COMSTOCK PUMPING ASSOCIATION

Virginia City, Nevada, October 29, 1913.

REPORT ON PROJECT OF THE UNITED COMSTOCK PUMPING ASSOCIATION FOR UNWATERING THE 2700 LEVEL OF THE NORTH COMSTOCK MINES, ANSWERING FORTY-SEVEN QUESTIONS OF WHITMAN SYMMES, SUPERINTENDENT OF THE MEXICAN MINE.

Whitman Symmes, Esq., Supt. Mexican Mine, Virginia City, Nevada.

DEAR SIR:—

Replying to your letter of October 2, I submit herein answers to your forty-seven questions in regard to my administration and my plans for further unwatering the North Comstock Mines. (See Appendix I for list of questions.)

In view of the obvious hostility of your attitude, I have considered it to be neither logical nor safe to reply to them separately

and in the order in which they are presented; but I have, nevertheless, taken care to see that every question is fully and frankly covered by this letter.

I will first reply to those questions which concern themselves with my administrative acts:

When I succeeded you January 25, 1913, I found myself in charge of a pumping installation which held the water at the 2500 level of the North Comstock Mines, to which depth it had been reduced by Messrs. Hall and Burbank, by October, 1910.

The pumping system may be outlined as follows:

All pumping was done through the C. & C. Shaft, at the collar of which the shops were located. Access to the pumps was had by means of the hoists working the said shaft.

The lowest pumps were the two electrically driven vertical turbine sinker pumps in the shaft sump at the 2500 level of the C. & C. Shaft. These pumps received the drainage from the 2500 level, together with the water rising from below the 2500 level. They discharged these waters to a tank on the 2310 station.

At the 2310 station were three electrically driven horizontal turbine station pumps which cast to the 2000 level the water received from the sump pumps at the 2500 level and also the drainage from the 2000 level to the 2300 level.

The discharge from the horizontal turbines, together with the drainage from the 1600 level to the 2000 level, entered a sump tank under the 2000 station and was thence elevated about 15 feet to a second tank by means of an air lift.

On the 2000 station three electrically driven Riedler pumps cast to the Sutro tunnel, about 16 feet above the 1600 level, the waters from the second tank.

The Sutro tunnel also received the drainage from above the 1600 level and thus became a vent for all the waters discharged from the North Comstock Mines.

The quantities of water were approximately as follows:

Flow from 2500 level and below it, 1000 gallons per minute.

Drainage from 2300 to 2500, 100 gallons per minute.

Shaft drainage, cooling water and pressure water for hydraulic balance, 400 gallons per minute.

Total duty of sump pumps, 1500 gallons per minute.

Drainage from 2000 to 2300 level, 600 gallons per minute.

Total duty of 2310 station pumps, 2100 gallons per minute.

Drainage from 1600 to 2000 level, 50 gallons per minute.

Total duty of 2000 station pumps, 2150 gallons per minute.

Drainage from above Sutro tunnel, 60 gallons per minute.

Total discharge to Sutro tunnel, 2210 gallons per minute.

A simple expression of these relations may be made by diagram as follows:

Drainage from above
Sutro Tunnel, 60 gal. per min.

60 g. p. m. ↓

Sutro Tunnel discharge pipe → Sutro Portal
2210 g. p. m.

2150 g. p. m. ↑

Drainage from
1600 to 2000
50 g. p. m.

50 g. p. m. ↘

2000 Level-Riedler Pumps

2100 g. p. m. ↑

Drainage from
2000 to 2300
600 g. p. m.

600 g. p. m. ↘

Horizontal Turbines at
2310 Station

1500 g. p. m. ↑

Drainage from
2300 to 2500
100 g. p. m.

100 g. p. m. ↘

400 g. p. m. ↙

Shaft drainage, cooling
water and pressure water
for hydraulic balance,
400 g. p. m.

Vertical Turbines at
2500 Sump

Deep flow,
1000 g. p. m. ↑

The installation described is by no means a logical one or even a good one, and presumably the whole of it will be replaced in

time by hydraulically operated reciprocating plunger pumps on the 2500 station. As soon as I had made a study of the situation I readily perceived that the conditions were ideal for the use of these engines, and, finding also that my last three predecessors, Messrs. Hall, Burbank and Symmes had each in turn finally urged their adoption, I promptly made them the subject of a special study which shows, first, that they could have been installed for a sum no greater than that which has been expended in the purchase of the vertical and horizontal turbines and the installation of the same, about $80,000 (See Appendix II), and, second, that the hydraulic engines could have been installed directly without the previous purchase of this so-called temporary plant.

However, the plant described was in fact actually holding the water at the 2500 level; but it was far from being in an efficient state for the further unwatering of the deep levels.

To begin with, conditions in the shaft sump were very bad indeed, as the whole shaft bottom was blocked with machinery which prevented access to the 2500 level by cage. The bottoms of the north and south compartments contained vertical turbine sinker pumps and the middle compartment was blocked to the 2000 level with the old hydraulic elevator and its pipes. The north compartment was nearly full of pipes and permitted only the use of a dolly cage to the 1800 level. The middle compartment permitted the passage of a cage only to the 2000 level. In the south compartment the cage could only go to a point 40 feet above the 2500 level, while materials were lowered thence by ropes and the men traversed this 40 feet through hot, vitiated, steam-laden air by means of a ladder. Obviously these conditions were intolerable and demanded patient correction if we were to anticipate any cleaning out of the 2500 level of Con-Virginia for gaining access to the winzes below the level.

To do this it was first necessary to remove the hydraulic elevator from the middle compartment, to lower another vertical turbine into place in the sump of that compartment, to then remove the vertical turbine from the south compartment and finally to extend the south compartment hoisting to the 2500 level. All of these things were done, and, as a result, we had two turbine sinkers in place as before and direct access to the 2500 level by the south cage while the middle compartment could be worked to the 2300 level.

There were other minor changes to be made before we would be in a secure position for attacking the problem of the further lowering of the water to the 2700 level. Thus, as fully discussed under my special reply to your question 12, it was necessary to eliminate the wasteful, injurious and absurd raising of water from the lower 2000 level tank to the upper by means of the air lift.

The thorough overhauling of the Riedler pumps, also had to be continued and, much to my surprise and annoyance, I found that the overhauling already accomplished had been so carelessly and hastily done that it had to be repeated.

It was found moreover, that there were reconstructive problems of organization and administration to be met, while the shaft changes were being effected; for discipline and system were entirely lacking in the mechanical department, while costs and office records were kept in the most obscure manner. This circumstance was the more serious as the new administration could not take remedial action without the loss of considerable time which was required for observation and deliberation. The mechanical department was overcrowded by a force of twelve men though seven men now do the work more thoroughly. They were but loosely related by shifting intrigue and cabal and appeared to have as a main principle of their cohesion, the acquisition of extra pay by work overtime. The department was headed by a mechanical engineer who made only a pretense of controlling the work nominally in his charge and who had apparently occupied most of his time as your personal assistant, doing work for the Mexican while he drew his pay from the Pumping Association.

For remedying these conditions it was found to be possible to thoroughly reorganize the mechanical department only after six weeks had passed. It was then put in charge of Mr. Louis Biddle, a master mechanic having years of experience, seasoned to the difficult conditions of our hot mines, devoted to the personal supervision of his work and capable of commanding the respect of his men. By this means the mechanical department was rendered singularly efficient though the total number of men employed was reduced to seven, as previously stated. (Part answer to question 43.) It appears from questions forty and forty-four that you hope to show this reduction in force to be a direct result of the completion of the overhauling of the Riedlers; but this has not been the case. When the overhauling of the Riedlers had been apparently accomplished we were astonished to find that part of this work which had been done previous to the reorganization of the mechanical department was highly defective; and it has been necessary to duplicate almost all of it from time to time. (Answer to question 44.)

When these first problems of the new administration had been successfully met, we were then only in a position to take up works directed to the further lowering of the water.

However this should be done it was recognized by all that the further unwatering must be accomplished either through the Con-Virginia winze, lying 600 feet east of the C. & C. Shaft, or through the Ophir-Mexican winze on the north boundary line of Ophir. My

predecessor had fully decided upon the use of the latter winze, which extends from the 2500 to the 2900. In order to use the Ophir-Mexican winze for pumping, it was necessary first to clean out and repair the old Con-Virginia-Ophir 2500 level from said winze to the C. & C. Shaft where the water from below the 2500 level must be delivered to the existing pumping plant.

This old 2500 level of Ophir-Con-Virginia, through which connection must be made between the shaft and the Ophir-Mexican winze, may be described as follows: A crosscut had been driven 600 feet east of the C. & C. Shaft to the Con-Virginia winze. Thence a northerly drift extended 1555 feet to the Ophir-Mexican winze. No matter how the attack should be made upon the cleaning out and repairing of the level, the progress of the work must inevitably lead incidentally to the securing of access to the Con-Virginia winze. The work of repairing this old 2500 level had already been started at the Ophir-Mexican winze and had been carried south 575 feet under very difficult conditions, as there was a down grade which caused the water to stand in the drift and necessitated the carrying forward of a pump with the advance of the work. It was decided to proceed no farther with the work from the Ophir side at that time as the repairing of the drift could now be carried forward from the C. & C. Shaft and with considerable advantage. The east crosscut from said shaft had a gravity drainage to the shaft; and the muck and debris could be hoisted directly instead of being always carried back a longer and longer distance to the Ophir winze for hoisting, whence it would finally require tramming back to the C. & C. Shaft again on a higher level. Another consideration of great importance in the selection of the C. & C. Shaft end for the attack upon the 2500 level, lay in the fact that work from that end would reach the Con-Virginia winze station in 600 feet and it was hoped that this winze would be found to be in good condition. If so there were many considerations to recommend its use for unwatering the 2700 level. It had not only the important advantage of closeness to the rest of the pumping plant at the C. & C. Shaft. It also presented the most quickly available point of attack for the lowering of the water while there was no particular reason to think the Ophir-Mexican winze was in a better state of repair than this nearer winze in Con-Virginia ground. If then, by chance, the Con-Virginia winze should be found in a state of good preservation, its use would avoid the necessity for connecting through to the Ophir-Mexican winze on the 2500 level before the lowering of the water to the 2700 level.

These considerations have proven themselves to have been well worthy of the attention they received. Rapid advance was made in the repairing of the level, the Con-Virginia winze was reached

and sounded and found to be in good condition and it has become immediately available for unwatering the 2700 level.

This concludes the preliminary discussion of conditions as I found them and of the early acts of my administration; but, before passing to a detailed consideration of my project for unwatering the 2700 level, I will grant your request of question 30 by introducing a copy of the only report I have so far presented. It covers my work to July 1, 1913.

Copy of Report.

General Office.

United Comstock Pumping Association.

Virginia City, Nevada, July 1, 1913.

A. F. Coffin, Esq., Pres. U. C. P. A., San Francisco, Cal.

Dear Sir:—

Pursuant to your request I herewith submit a report on the cost of operating the United Comstock Pumping Association in Virginia City and work done by the Association since I took charge of its operations on January 25, 1913.

The following is a statement of the cost of operating the United Comstock Pumping Association from December 1, 1912, to June 1, 1913, compiled by our accountant, Mr. F. E. Patton.

Months	Regular Expenses	Extra Expenses	Total Expenses
December	$16,581.33	$3,138.26	$19,719.59
January	17,393.36	3,000.00	20,393.36
February	15,849.68	2,208.80	18,058.40
March	15,363.30	869.52	16,232.82
April	14,436.88	840.81	15,277.69
May	13,712.28	1,944.21	15,656.49

The above figures speak for themselves.

The items comprising the regular operating expense include salaries, labor, supplies, power, water, hoisting, compressed air, all repairs on pumps and the pumping system, and the general expense of maintaining the Association. All supplies used, with the exception of ladders which were taken from the Ward Shaft, have been charged to the above named account.

The extraordinary and installation expenses comprise such expenses as the cost of Mexican-Ophir winches, damages through personal injury, cost of removing hydraulic elevators, repairing and preparing shaft for the lowering of the 2500 turbine pump, repairing 2500 station and east drift, etc.

The principal cause of our greatly reduced operating expenses since my appointment, is the fact that we have raised the efficiency

of our labor and thereby conducted the work with fewer men. We have also made many changes in the operations of the pumps which were along the lines of economy.

The following is a record of work accomplished under my administration as superintendent:

Removed hydraulic elevator No. 1 from the center compartment of C. & C. Shaft.

Repaired shaft from 2000 to 2300 station and removed ladders and electric cable from middle compartment to the north compartment of C. & C. Shaft between the 2000 and 2300 levels. This work permitted the cage in the middle compartment to be lowered to the 2300 level and saved considerable expense in operating the C. & C. hoist because we were enabled to run the cages in counterpoise when hoisting ore and waste.

Thoroughly tested and adjusted a new vertical turbine pump on the surface and installed it in the shaft at the 2500 level.

Removed the 2500 level vertical turbine pump from the south compartment of the C. & C. Shaft and thoroughly overhauled the same. By the removal of this pump we were enabled to lower the south cage to the 2500 level of the C. & C. Shaft.

Repaired 2500 station of C. & C. Shaft and cleaned out and repaired the 2500 east drift to the Con-Virginia winze, a distance of 565 feet. At this point we proceeded to clean out and repair the north drift and have advanced the same a distance of 300 feet. (June 29, 1913.)

Put in new ladders in the north compartment of the C. & C. Shaft from the 1000 level to the 1600 level.

Rearranged the system of pumping the water from the 2310 pumps to the 2000 Reidler pumps so that the 2310 pumps pump directly to the upper Riedler tank. By this arrangement it is not necessary to operate the 2000 air lift continuously. Also by this new arrangement of pumping, the ventilation of the C. & C. Shaft has been greatly improved, the life of the timbers has been extended and a good saving in power has been effected.

Inaugurated a system of accounting whereby the operating expense of the United Comstock Pumping Association is segregated and charged to the different departments. This work assisted in reducing our expense.

All of the above work excepting the system of accounting and the discontinuance of the constant use of the 2000 air lift is, and was necessary to be done before the actual work of unwatering could proceed.

Please remember that since I have been in charge of the United Comstock Pumping Association we have been greatly hampered by having very little financial assistance to be used in the work of unwatering these mines.

The results have been very gratifying. Credit for the work accomplished, under our adverse financial condition, and the greatly reduced operating expenses of the Association is due to the co-operation and friendliness of Mr. T. F. McCormick, Superintendent of the Con-Virginia and Ophir mines; Mr. Thos. Blake, foreman of the Con-Virginia and Ophir mines, and our Master Mechanic, Mr. Louis Biddle.

Very respectfully submitted,

(Signed) A. M. Walsh,

Superintendent.

Project for Unwatering 2700 *Level through the Con-Virginia Winze.*

Having the above general view of the pumping situation as I found it, and of my preliminary steps toward the gaining of access to the winzes, we may now logically consider the evolution of my project for unwatering the 2700 level.

Choice of Winzes.

The choice of a winze for pumping operations lay between the Ophir-Mexican Winze and the Con-Virginia Winze. Each of them had three compartments. Each was cribbed and each had been sounded and appeared to be unobstructed.* Each had ample sump room below the 2700 level, as the Con-Virginia winze extends 120 feet below that level, while the Ophir-Mexican winze connects with the 2900 level. Neither winze had an advantage in gravity, drainage of the 2700, as the connection between them on the 2700 was probably made by drifting from each toward the other, so from each the grade rises to a high point where the drifts connected.
This factor proves to be so important that it may be well to give it full discussion at this place. There are no written records of grade on the 2700 level known to me; and I believe information

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*Note:—Results of sounding Con-Virginia Winze were as follows:

(Answer to question 2.)

South Compartment. Open 195 feet below the winze collar. There the sounder met obstruction which it readily passed to the 265 foot point where it stopped. As this was the pump compartment some obstructions by platform, pump hangers, etc., was to be expected.

Middle Compartment. Sounder passed without interruption to the 320 foot point, the winze bottom.

North Compartment. Sounder passed without interruption to point 200 feet below the winze collar where the compartment appeared to be boarded over.

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on this subject must remain a matter of memory on the part of miners who worked upon the level, a source of information your work at the Ward Shaft has shown to be exceedingly treacherous. Assuming, however, that the grades do rise from each winze toward a high place between them, it must appear that the level could not be wholly unwatered by direct pumping from either winze. Pumping from the Ophir-Mexican winze would leave water standing anywhere from five to ten feet (according to grade) on the Con-Virginia winze 2700 level station; and, conversely, pumping from the Con-Virginia winze would leave a like unknown depth of water on the 2700 level station of the Ophir-Mexican winze.

Now it is obvious that in order to work the 2700 level of the Con-Virginia and Ophir, air from the C. & C. Shaft must be permitted to pass through the Con-Virginia winze and the 2700 level at least as far north as the Ophir-Mexican winze. Therefore were the unwatering conducted from the latter winze it would still be necessary to have auxiliary pumping of the water which would stand in the Con-Virginia winze, just as the Con-Virginia winze project must include auxiliary pumping to clear the 2700 station of the Ophir-Mexican winze.

In either case there would be two possible methods for conducting the auxiliary pumping, as the second winze could be pumped directly to the 2500 level, or it could be approached by cleaning out the connecting level on the 2700 and advancing pumps through the same to lift the water across the high point. The latter procedure would, of course, be the more attractive if the 2700 level should be found in such good condition as to offer hope of rapid advance in its repair. As the old 2700 level lies much farther east of the east vein than the old 2500 level, there is a good basis for anticipating that it is in more solid ground and therefore in better condition than the old 2500 level.

Another factor having a bearing on the choice of a winze for the main pumping and also upon our plans for auxiliary pumping when the first winze shall be cleared is that of the location of the principal water flow rising from below the 2700 level, as we would wish to apply the auxiliary pumping to the smaller flow of water. If, for instance, it were known that either winze were a reservoir for a greater flow of water than the other, it would be desirable to select for the location of the main pumping plant the winze draining the larger flow. But here again we are confronted

by a painful dearth of data, as we have no records of the location of water flows on the 2700 level. All we know is that the Con-Virginia and Ophir have been the wettest ground; that Con-Virginia exhibits on the upper levels a distinct water belt from which a large flow is derived; and that the Con-Virginia winze was stopped 120 feet below the 2700 by a heavy flow of hot water. From the memory of men who saw the water flow it is deemed probable that the Con-Virginia winze alone receives as much as 250 gallons per minute from the depths of the Lode; and, as the up grade from the 2700 station of this winze passes through the wettest part of the Lode, including the whole of the water belt referred to, it may reasonably be assumed that the total flow into the Con-Virginia winze is greatly in excess of that to the Ophir-Mexican winze. Nevertheless the most careful analysis only establishes the fact that with an entire lack of accurate data upon grades and water flows on the 2700 level, the formulation of all plans which depend upon precise knowledge of these conditions must necessarily be deferred until the unwatering of the first winze shall give us the factors we require for an intelligent solution of this part of our problem. (Answer to question 20.)

Returning now to our main subject of a comparison of the relative advantages of the two winzes for the unwatering, small difference has so far been shown in the values of the winzes, as a slight advantage lying with the Ophir-Mexican winze by reason of its connection with the 2900 level is offset by a slight advantage of the other winze in a presumption that it receives a larger flow of water.

There are, however, four other important considerations which, as a whole, were found to be so decisive as to require the use of the Con-Virginia winze.

In the first place, the Con-Virginia winze stood but 600 feet away from the C. & C. Shaft, in and adjacent to which the rest of the pumping plant was located, while the Ophir-Mexican winze was situated at a point 2155 feet from the shaft, measured along the old 2500 level. The many advantages of compactness in such a plant are too obvious to require discussion.

In the second place, the use of the Ophir-Mexican winze would require the cleaning out and repairing of about 600 feet of drift on the 2500 level which could be avoided, at least temporarily, by using the Con-Virginia winze. This repair work would be very costly, would consume much time and also involve peculiar difficulties from water accumulation due to grades. As the refusal of Mexican and Union to meet their obligations for the expense of pumping had greatly limited the funds at my disposal, any possible saving of time and money was of such importance that this factor alone seemed to demand the use of the Con-Virginia winze.

A third decisive point lay in the fact that the employment of the Con-Virginia winze for pumping would leave the Ophir-Mexican winze free for mining operations as soon as arrangements had been effected to conduct its waters across the rise in grade to the Con-Virginia winze. For mining work, its central location made it singularly desirable, especially for the Mexican mine, which, presumably, has an ore body on the 2700 level awaiting development. If, however, the Ophir-Mexican winze, were used for permanent pumping, the Con-Virginia winze, being at the extreme south end of the mines, would not be equally useful for mining purposes.

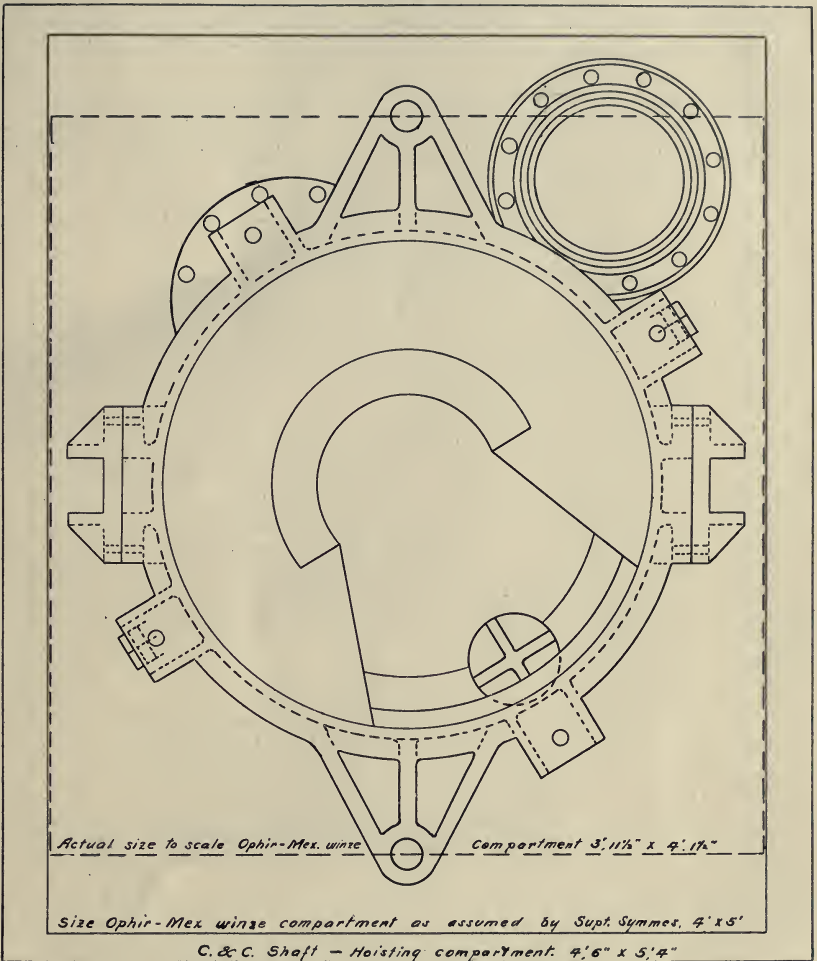
The fourth factor is one which will greatly astonish you, as it involves an error in observation of the grossest kind on the part of my predecessor in the management here, which has already occasioned heavy losses and might have caused much further loss of time and money had the former plans for unwatering the 2700 level been adopted by me. This factor is the smallness of the compartments of the Ophir-Mexican winze, which are of a size utterly precluding the passage of the electrical turbine sinkers through them.

On assuming the management I found, among the papers of the Pumping Association, a drawing of the Ophir-Mexican winze compartment, which shows it to be four feet wide and five feet long. Compartments of this size might, theoretically, permit the passage of the electrical sinker, though actually there would be serious difficulties involved in the operation.

However, a careful examination of the winze disclosed the fact that its compartments are really but 3 feet 11½ inches wide by 4 feet 1½ inches long, a circumstance accounted for by Mr. McCormick as follows: In former times each mine made its own ore cars from designs more or less dependent upon the caprices of the various superintendents. In this way it chanced that Con-Virginia used rather large cars, which resulted in winze compartments in that mine of a size, 4 feet 4 inches by 4 feet 7 inches, while Ophir on the other hand, had only small cars, for the passage of which smaller winze compartments were adequate. When you made your plans for using the electrical sinkers in the Ophir-Mexican winze, it appears that you must have deceived yourself by a failure to sound and plumb the winze beneath the water level at its collar. If you should now care to do this you will find that the compartments really measure 3 feet 11½ inches by 4 feet 1½ inches as I have stated, except in the first four feet below the winze collar, where the timbers are widened out to allow room for the installation of chairs for the cage.

Let us, therefore, consider how this condition affects the possible use of the Ophir-Mexican winze for pumping. When you

DIAGRAM 1



Drawing to scale of electrical turbine sinker pump, showing

1st Outer rectangle (4'6" x 5'4") as pump hangs in C. & C. shaft compartment, through which it was lowered and raised with difficulty due to swinging of pump and binding of parts against timbers.

2nd Middle rectangle (4' x 5'), wholly fictitious diagram showing Ophir-Mex. compartment as erroneously portrayed in U.C.P.A drawing left among records of Mr. Symmes' administration.

3rd Inner rectangle (3' 11½" x 4' 1½") actual size Ophir-Mex winze compartment through which pump could not possibly pass.

first lowered one of the turbine sinkers through the C. & C. Shaft, the operation required eight hours. When I, myself, have either lowered or raised one, I have found it a dangerous and tedious task because of the tendency of the pump to swing and bind itself against the timbers, so that it had to be repeatedly pried out again with crowbars; and I have become convinced that the C. & C. Shaft compartments though 4 feet 6 inches by 5 feet 4 inches are none too roomy for the passage of these pumps and about as small as they should be. (See Diagram I.)

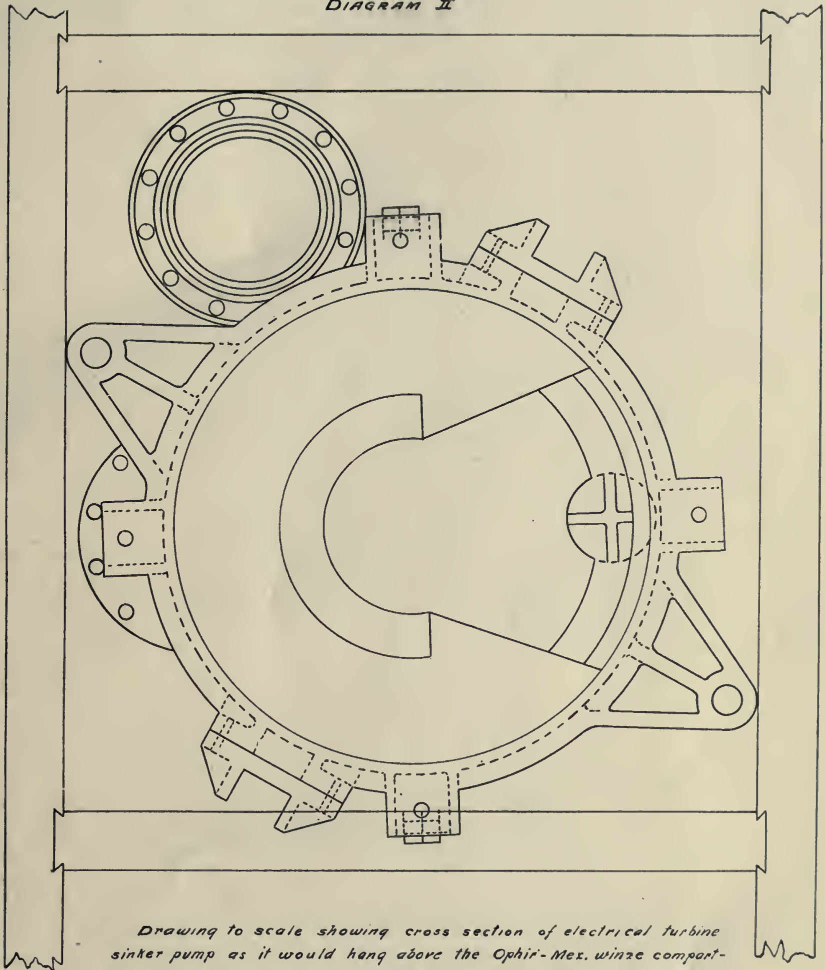
Had the Ophir-Mexican Winze compartments been four feet by five feet as shown by diagram left by you in the office records, it would even then have been almost a hopeless task to pass the pumps through them. But as the compartments actually are, this would be entirely out of the question. If the pumps were hung above them as they were intended to be hung they would protrude about 6 inches into the timbers.

As a matter of purely academic interest I have placed a cross-sectional drawing of the pump on tracing cloth and turned it about over a diagram of the winze compartment to ascertain the most favorable position in which the pump could be presented to the winze. The result is shown in diagram No. 2, and even so, the pump would protrude a minimum of 2½ inches into the timbers, assuming a theoretical clearance of nothing for the other parts of the pump. However, we cannot venture to assume the winze is perfectly straight by any means and a pump 16 feet long would require some additional clearance to allow for this factor. Moreover, in an old cribbed winze, we can be sure some of the timbers will protrude as much as two inches; and in some places we may expect such bulges to be found on both sides. Therefore, it may be taken as an entirely safe assumption that the winze would need to have a clearance of at least six inches over an exact fit when the pump is in the most favorable position for passing through the compartment which means that at least one dimension of the winze must be as much as 8½ inches greater than it is. But even this would only give a fighting chance to lower the pump, as a 6½ tons pump lowered in free suspension on a cable without guides is not a sufficiently reasonable thing for consideration in conservative engineering practice.

As it may save you further confusion, it may be well to mention that if you have copies of the same turbine pump drawing I found in the office, it is not to be depended upon to furnish a true cross-section of the pump, as it is incorrect. The cross-sections shown in my diagram represent the pump as it actually is.

Summarizing this fourth decisive factor it is seen that the Ophir-Mexican winze could not possibly be used for the turbine

DIAGRAM II



Drawing to scale showing cross section of electrical turbine sinker pump as it would hang above the Ophir-Mex. winze compartment in the most favorable position for passing through the same.

If said pump, weighing 6½ tons, could be lowered and operated without guides, freely suspended on a cable, and could be conceived to require no clearance whatever within the timbers, even under such a purely theoretical assumption, it would still protrude 2½ inches into the timbers.

sinker pumps, and that whatever pumps should be employed would be much more cramped in it than in the Con-Virginia winze.

For these reasons it was finally decided, after counsel and deliberation, that the Con-Virginia winze should be used for our pumping operations to the 2700 level.

Selection of Pump for Unwatering the Con-Virginia Winze.

(Answering Questions 1 and 2 concerning the basis of my judgment in selecting the Starrett pump.)

For unwatering this winze, nothing would ordinarily be thought of but the old and well-tried common air sinker pumps with which all are familiar and which are typically used in conservative practice throughout the world; but with us it was different, as we had available for use the electrical turbine sinker pumps which you had bought. We were also offered the free use of Starrett sinkers by the manufacturers of these pumps. My choice finally lay between the Starrett sinkers and the electrical turbine sinkers, as I had no money for purchasing plunger pumps actuated by air and would not in any case make new purchases until convinced that the machinery at my disposal could not be made to serve.

The Starrett pump, as you know, consists of two chambers in a massive casting to which, after submergence, compressed air is admitted in alternation with the water to be pumped. The shifter valve is practically the only mechanism and the resulting simplicity is a feature of great promise for operations in our hot winzes. I had never seen these pumps operated but had discussed them with men who had done so. I also inspected a report upon a test made of these pumps at the Massachusetts Institute of Technology by Edward F. Miller, Chas. W. Berry and E. W. Taylor, together with half a dozen letters of recommendation by users of the pump, all of which were singularly satisfactory. Letters from G. W. Lambourne, General Manager of the Daly-Judge Mine at Park City, Utah; W. J. Stevenson, Superintendent of the Helena Mining Company at Leadville, Colorado; Elias Cohn, Manager of the Smuggler at Aspen, Colorado, and J. R. Champion, Superintendent of the Yak Mining, Milling and Tunnel Company at Leadville, contained ample evidence of the usefulness of the pumps and of the fact that they had passed the stage of a mere experiment. The last mentioned letter was peculiarly significant as it referred to the employment of a Starrett pump when all the other pumps had been put out of commission by a flood from a subterranean water course, a menace to which we are liable at all times on the Comstock.

The only unfavorable thing I knew of the Starrett pump was that it was supposed to have failed in a test made upon it by you

at the Ward Shaft. However, I was not unaware, that, though your compressors were reported to deliver a much larger quantity of air, a check of this matter by a capable engineer had shown, by most convincing indicator cards, that the actual performance was but 930 feet. I was also advised that this air had been delivered through 2000 feet of pipe, most of which was an old rusted discharge pipe for water, through which the leakage must have been very great, as much perhaps as 100 feet per minute. It is furthermore a matter of common report here that the old air pipe was so rusted and full of holes that it constantly delivered metallic debris to the pump in sufficient quantities to choke the action of the shifter valve. Mr. Mackie, who was sent to operate the pump under you, testifies that the pump lowered the water of the Ward Shaft 79 feet in seven and one-half hours, that it stopped then only because of metallic scales and rust which were afterward found in the valve when the pump had been raised—and while of course the water was also rising. He further states that, as he could not be present at the pump all the time, it was impossible to accomplish anything in consequence of the indifference of the assistants you assigned him; that he repeatedly lowered the water on the day shift and found the water level back again at its old position upon his return the next day; and that he suddenly entered the Ward Shaft hoisting works late one night, had himself immediately lowered and found your entire crew lying down on the cool concrete floor of the 2100 station, while a prompt inspection of the pump showed all the air valves of the same to be wide open, without any throttling, as a result of which all the air the compressors could possibly furnish merely drove directly through the discharge valves into the column pipe without actuating the shifter. Obviously it would have been childish to allow the results of this so-called test of the Starrett pump any weight in my opinion of it; and I concluded that the probability of its successful operation was sufficiently great to justify its trial if it seemed to be applicable to my conditions.

Now, passing to a choice between the electrical turbine sinkers and the Starrett pumps, it is notable to start with, that the electrical turbines would be used at low efficiency, as they were designed for 2200 gallons per minute, while their pumping duty would be only about 1000 gallons per minute. However, efficiency is in no sense a controlling factor for such a temporary purpose and we could well afford to be extravagant in the use of power for the short time involved in lowering the water.

Of far greater importance is the fact that, being dependent upon electric power, we are always menaced by the possibility of a sudden shut down. You are aware that during the cold weather last January this condition became a serious danger to the Lode; and during the severe electrical storms last summer the power was

off a number of times. In the former case the 2500 level was long flooded, the power being off, or so weak as to be of little service, for many hours on several occasions. In the latter case the power was off nearly every day for weeks; and, on one occasion for as long as two hours. It is only too obvious that such a shut-down of power occurring at a time when the electrical sinkers were in an unfavorable position, might be expected to put them out of commission, as the water would rapidly rise above the motors. I candidly admit that with considerable difficulty plans might be conceived which would give only a fighting chance for withdrawing them. I am also aware that the motors are heavily insulated and that, when new, they are supposed to be capable of operation under cold, non-acid water for two hours; but I have observed the rapid deterioration of the insulation in which they are baked when they are merely exposed for a short time to our hot, moist air, and the effects to be expected from their actual immersion in the hot, acid waters of the Lode would not justify a hope that there would be much chance for their operation under water if they had been covered by it even a short time. Such a submersion would also involve a difficult problem in the lubrication of the electrical pumps while they were pumping themselves out after a shut-down, as the oil would soon be replaced by water after the motors started up if they should be capable of doing this at all.

Of course the danger of sudden flooding from the breaking loose of dammed waters would be directly comparable to that arising from a shut-down of the power.

While, as a last resort, one might take a chance that there would be neither a shut-down of power nor flooding, the method would hardly do credit to an engineer who could by any reasonable means eliminate these dangerous uncertainties from his project.

Turning now to the Starrett pump it is found that it is not in the least injured by submersion, as a return of power to the actuation of the compressors after a shut-down would unquestionably start the pump, however long it had been under water; and it would quickly pump itself out again. Moreover, these pumps should work at their maximum efficiency in hot water, the heat energy from which would inevitably be absorbed by the compressed air and used in its expansion. In short, it may be said that, if there is a place to which the electrical sinker does not apply, it is on the North End Comstock; while the converse is true of the Starrett pump. If it is good anywhere it should be better here and a demonstration of its applicability would materially simplify the problem of the ultimate unwatering of the Lode to the lowest workings. This last consideration has made me particularly anxious to see that the Starrett pump shall have a fair and unprejudiced trial.

For these reasons there appeared to be no occasion to hesitate in a choice between the Starrett and the electrical sinker; and the

Starrett was accordingly selected for the work. For its successful operation I make no guarantee, though of course I anticipate that it will do the work required of it, and I assume full responsibility for the wisdom of trying it. If it proves a success, this pump will become an indispensable factor in other plans for unwatering the deep levels. If it does not, but little loss will have been incurred, as we have paid nothing for the pumps themselves and practically every single expense which will have been incurred up to the trial of the pumps would have been necessary and inevitable had we not considered them at all. Under such circumstances I am convinced that my decision to try these pumps is good engineering, is logical and inevitable.

Water flow on the 2500 *Level.*

(Answering Question 6.)

A measurement by weir of the flow of water to the Shaft from the East Crosscut on the 2500 level indicates 1000 gallons per minute as the total.

Two hundred and seventy-five gallons of this are flowing from the drift which goes from the Con-Virginia winze toward the Osbiston Shaft. As this water can be caught up and conducted past the winze, there should be a flow of 725 gallons per minute rising in the winze at the start of pumping. In addition, allowance must be made for an uncertain amount of water which will drain into the winze from below the 2500 level, as the water is lowered. This flow will steadily increase with the lowering of the water level and will continue for some time after the 2700 level is reached. While we have no basis on which to estimate this flow of water, some recognition of it must be made; and it is arbitrarily assumed that it will amount to 100 gallons per minute at the 2700 level. The Starrett pump used must therefore have a capacity of not less than 825 gallons per minute and a reasonable safety factor should be added.

Description of the Starrett Pump Selected for Unwatering the 2700 *Level.*

The pump selected for the winze duty is one having chambers of 50 gallons capacity, which is to be worked at 20 strokes per minute. It therefore has a capacity of 1000 gallons per minute, though the speed may be increased if necessary. (Part answer to Question 3.) This pump has a massive casting of great strength. It has no protruding weak parts and is capable of supporting the 8 inch standard pipe discharge column (Part answer to Question

25) which will be placed directly upon it. Its gross measurements are 40 inches by 45 inches by 6 feet long. The shifter valve is of the new type with positive action.

Description of Proposed Method for Unwatering Operations at the Winze.

(Answering Question 4 as to proposed method for unwatering winze.)

It is planned to lower the water with the two Starrett pumps, each of full estimated capacity for doing the necessary work. (Part answer to Question 3.)

They will be placed in the north and south compartments of the winze, while a dolly hoist will be worked in the middle compartment, in which the ventilating pipes will also be accommodated, together with a ladder way. There will be two winches and a hoisting engine in the station, for moving the pumps and operating the cage. The 8 inch discharge columns, and also the compressed air pipes, will be suspended upon the pumps and will be extended from time to time by the addition of pipe at the winze collar, a method, you will observe, which would be exceedingly dangerous if attempted with the delicate sinker pumps. (Answer in part to Question 25.)

The pumps will be alternately lowered about eighty feet at a time. Presumably they will gain on the water flow in the winze at a rate of about 175 gallons per minute. The water storage capacity of the six winzes and the Union Shaft, which are connected through the 2700 level, is estimated at 3740 gallons per foot of depth. The pump may therefore be expected to lower the water so fast that we cannot expect to keep up with it in the auxiliary work; but we can not estimate the actual time which will be required to reach the 2700 foot level, as we do not know what repairs to the winze will be necessary to insure the safety of the men. We will probably discontinue the winze pumping from time to time in order to carry with us the repair work on timbers and the placing of guides, ladders and ventilating pipes. The cribbing between the hoisting compartment and the pumping compartments will be cut away at convenient places to permit the passage of men, debris and materials. (Answering Question 23.) As each pump completes its stage and is unwatered by the other pump it will be carefully inspected. Its valves will be cleaned and its screens will be replaced if necessary.

There is little reason to anticipate the necessity of any important repairs; but should such an emergency arise we will make them in the winze itself, while the water level is being held by the other pump. However, it would be a simple matter to with-

draw a pump at any time and hoist it to the surface, as this would involve nothing but the removal of the discharge column and compressed air pipe, when the joints of the same should be brought in succession to the winze collar by the winch. (Answer to Question 16.)

The hot air and steam from the pump discharge will be bonneted and sprayed with cold water to effect condensation of steam and lowering of temperature, after which it will be conducted into the north drift on the 2500 level, through which it will pass to the established up-casts. (Part answer to Question 19.)

For the actual operation and lowering of the pumps, only a single man beside the hoisting engineer will be needed, but two men will always be worked together in the winze, as required by law. There will also be whatever additional crew the timber repairs and pipe installations may require, but the total number of men employed must depend upon conditions as we find them, a total which will not in any case exceed the number required for the installation of any other type of pump. (Answering Question 22.)

It is notable that there will be a certain fixed amount of work to be done in the winze, though it cannot be estimated at present. However, it will be highly advantageous to do this work as quickly as possible; and I shall accordingly use as large a crew as can be conveniently worked. If the heat requires it, the men will work in relays. I have selected Mr. W. B. Mackie to supervise the operation of the pumps. He comes to me highly recommended by the manufacturers of the Starrett pump, as an able mechanic familiar with the operation of the pump through years of experience with it. The mining work in connection with the winze will be in charge of Superintendent McCormick and Foreman Blake of the Con-Virginia Mine, whose peculiar fitness for this work needs no discussion. (Answering Question 26.)

By this procedure the water will be lowered to a point about 20 feet below the 2700 level, (Answering Question 5) the winze having a total depth of 120 feet below the 2700. A further lowering of the water will be undertaken only if it appears that we require more than 20 feet of sump room. The sump requirements must continue uncertain pending the selection of a permanent plant for holding the water; (Answering Question 15) for, upon arriving at the 2700 level, I shall replace the Starretts by other pumps unless their efficiency should make them desirable for permanent station service.

Compressed Air Requirements.

(Answering Questions 7 and 8.)

The Starrett pump, having chambers of 1000 gallons capacity per minute, will take 133.7 cubic feet per minute, of air at such pres-

sures as may be required by the head under which the pump may be worked. It is expected that but 15 pounds per square inch gauge pressure will be used at the commencement of pumping and that this pressure will be increased to about 50 pounds at the 2700 level. (Part answer to Questions 10 and 11.)

With an atmospheric pressure of about 11.7 pounds at the shaft collar and fifty pounds gauge pressure at the pumps, the volume of compressed air will be nineteen hundredths of its uncompressed volume. Therefore the 133.7 cubic feet of compressed air entering the pump chambers at the 2700 level will contain 5.263 times that volume of free air, or 703.7 cubic feet, no allowance being made for differences of temperature.

In addition to the air delivered to the chambers, compressed air is introduced into the discharge column to reduce the pressure therein. The amount of air required for this is stated empirically at about one-third of the total air, which would indicate 352 cubic feet per minute as required for the discharge column.

An allowance of 50 cubic feet may be made for leakage between compressors and pump.

Our theoretical requirements for air are as follows:

For pump chambers	704 cubic feet per minute
For discharge column	352 cubic feet per minute
For leakage	50 cubic feet per minute
Total	1106 cubic feet per minute,

to be delivered by the compressors.

Compressed Air Transmission.

(Answering Question 9.)

This air will be conducted through the 6 inch standard pipe already in use in the C. & C. Shaft. Said pipe is not as large as it should be for proper efficiency; but our financial condition makes its employment imperative.

From the bottom of the shaft to the collar of the winze, 8 inch standard pipe will be installed. The pipe to be used from the winze collar to the pumps will be 3 inch standard pipe to the air chambers and 1½ inch standard pipe to the discharge column, as recommended by the pump manufacturers. (Part answer to Question 25.)

Air Compressing Plant.

(Answering Question 13.)

To contribute to our meeting of the above stated requirements for compressed air, we are installing at the C. & C. Shaft the two small compressors which were at the Ward Shaft. However, as

they were not bought especially for this service they must be regarded only as additional units in an aggregation of four compressors which will constitute the C. & C. Shaft installation for air compression. (Part answer to Question 9.)

These four compressors are described as follows:

Con-Virginia Big Compressor.

Made by Ingersoll Sergeant Drill Company.
Two Stage, duplex type. Belt driven from electric motor.
Stroke 24 inches.
Speed, 96 revolutions per minute.
Diameter low pressure cylinder, 28¼ inches.
Gross cylinder displacement, 1671.40 cu. ft. per minute.
Displacement volume of piston rod and suction tube, 66.86 cu. ft. per minute.
Net theoretical displacement 1604.6 cu. ft. per minute.
10% loss allowed for in valves etc. 160.4 cu. ft. per minute.
Approximate capacity 1444.2 cu. ft. per min. of free air at shaft collar.

Con-Virginia Small Compressor.

Prescott-Scott & Company (old Rand Type.)
One stage. Belt driven. Connected to electric motor.
72 revolutions per minute.
Stroke, 30 inches.
Diameter cylinder, 16½ inches.

Gross cylinder displacement	534.56	cu. ft. per min.
Displacement volume of rod	3.92	cu. ft. per min.
Net theoretical displacement	530.64	cu. ft. per min.
10% loss allowed	53.06	
Approximate capacity	477.58	cu. ft. per min.

Pumping Association Compressor Number One.

Ingersoll-Sergeant Drill Company.
2 stage, duplex type, belt driven, connected to electric motor.
160 revolutions per minute.
Stroke, 14 inches.
Diameter low pressure cylinder 19¼ inches.

Gross cylinder displacement	754.54	cu. ft. per min.
Displacement volume of piston rod and suction tube	27.67	cu. ft. per min.
Net theoretical displacement	726.87	
10% allowance for losses	72.6	cu. ft. per min.
Approximate capacity	654.18	cu. ft. per min.

Pumping Association Compressor Number Two.

Ingersoll-Sergeant Drill Company.
Two stage duplex type, belt driven connected to electric motor.
120 revolutions per minute.
Stroke 14 inches. Diameter low pressure cylinder 19¼ inches.

Gross cylinder displacement	565.91	cu. ft. per min.
Displacement of volume of piston, etc.	21.19	cu. ft. per min.
Net theoretical displacement	544.72	cu. ft. per min.
10% allowance for losses	54.47	cu. ft. per min.
Approximate capacity	490.25	cu. ft. per min.

Summarizing, it will be seen that our battery of compressors has the following capacity:

C. V. Big Compressor	1444	cu. ft. per min.
C. V. Small Compressor	477	cu. ft. per min.
P. A. Number 1	654	cu. ft. per min.
P. A. Number 2	490	cu. ft. per min.
Total	3065	cu. ft. per min.

all of which will be employed at about 80 pounds gauge pressure. (Part answer to Questions 10 and 11.) It should be mentioned here that though the Pumping Association compressors are reported to have made but 930 cu. ft. per minute while in operation at the Ward Shaft, it is anticipated that a thorough overhauling will bring their capacity to approximately the figure stated.

With an ample allowance for friction or other losses and allowing that the compressors will be operated constantly at full load, though, of course, this will not be the case, the compressors would require about the following horse-power. (Answer to Question 14.)

Con-Va. Big Compressor	250 H. P.
Con-Va. Small Compressor	84 H. P.
P. A. Number 1	114 H. P.
P. A. Number 2	86 H. P.

Obviously, as the total supply of compressed air available is thus nearly three times as great as that required for the pumping alone, there is no occasion to anticipate any difficulty from a lack of air. Ordinarily there will be nearly 2000 cubic feet per minute available for use in mining operations, which is considerably in excess of present requirements for that purpose. It is improbable that more than three compressors will be operated at once; and the wide range of compressor capacities will enable us to select such a combination of compressors as will closely meet our requirements, however they may vary with the depth of pumping or the fluctuating needs of the mine for more or less air for drilling.

Summary and Index of My Answers to Your Forty-Seven Questions; And Answers to Questions not Previously Discussed.

As the necessities of logic and of my self-protection have required an orderly and clearly related arrangement of my replies, while I wish to make it very clear that every question has been fully answered, I will now summarize my answers to each and every question by reference to the pages on which they may be found:

Questions 1 *and* 2. Concerning the basis of my judgment in selecting the Starrett pumps, is answered under topic, "Selection of Pumps for Unwatering the Con-Virginia Winze," p. 18.

Question 3. Concerning the number of pumps to be used, the capacities of same and of the displacement chambers, is answered under topic, "Description of Starrett Pump Selected for Unwatering the 2700 Level," p. 21, and under the next topic, following page.

Question 4. As to the method proposed for lowering water in the Con-Virginia winze, is answered under topic, "Description of Proposed Method for Unwatering Operations at the Winze," p. 22, et seq.

Question 5. As to the depth below the winze collar to which we propose to lower the water, is answered on p. 23.

Question 6. As to measurements of water and estimates of same, is answered under topic, "Waterflow on 2500 Level," p. 21.

Question 7. As to the quantity of free air to be used in pumping is answered under topic, "Compressed Air Requirements," p. 23.

Question 8. As to the proportions of air to be used in displacement chambers and discharge column, is answered under topic, "Compressed Air Requirements," p. 24.

Question 9. As to the sizes of compressed air pipes, etc., is answered under topic, "Compressed Air Transmission," p. 24 and the following topic.

Questions 10 *and* 11. As to the air pressures at the compressors and at the pumps at commencement and finish of unwatering, is answered at pp. 26 and 23.

Question 12. As to the quantity of air to be used in operating air lifts between the two tanks on the 2000 station.

Answer: The air I propose to use in operating the air lift between the two 2000 station tanks, is practically negligible, as the quantity consumed will remain about as at present. We do not contemplate any storage in the lower tank, excepting that of occasional overflow water from the upper tank, which tank is watched so carefully that there is very little overflow. I wish to point out that the system existing when I took charge allowed the drainage from

the levels between the 1600 and the 2000 to enter the lower Riedler tank from which it was necessary to elevate it again into the upper tank by an air lift. At present the air lift is freed from the burden of this drainage water which is conducted directly to the upper tank. Moreover, a far more important factor in reducing the duty of the air lifts is found in the fact that under the procedure existing when I took charge, the entire volume of water from below the 2000 level (approximately 2100 gallons per minute) was, by singular oversight, allowed to lose its momentum by coming to rest in the lower tank, from which it had to be elevated to the upper tank by the air lift. Of course one of my first duties was the remedying of this inefficient condition and the water from the lower levels is now also discharged directly into the upper tank. The total burden upon the air lift will thus appear to be quite insignificant, and while the quantity of air used in said lift can not be figured, the smallness of the amount is suggested by the fact that the air introduced is admitted through a 2 inch valve opened only a ⅛ turn from its closed position. Most of the time it is closed entirely. It may be noted in passing that there are singular advantages arising from the discontinuance of the heavy duty upon this air lift, as the exhaust air, becoming saturated in hot water, cast great volumes of steam into the 2000 station and to a notable degree vitiated all the air passing down the shaft below the 2000 level, thus shortening the life of the timbers and seriously impairing the ventilation.

Question 13. As to the compressors to be used and their speeds and capacities, is answered under topic, "Air Compressing Plant," p. 24 et seq.

Question 14. As to the horsepower for operating compressors and quantity of air provided for the mines, is answered under topic, "Air Compressing Plant," p. 26.

Question 15. As to proposed sump at bottom of Con-Virginia winze is answered on p. 23.

Question 16. As to method of repairing pumps, etc., is answered on p. 22.

Question 17. As to means of ventilation for men working on the pumps. Answer: Cool air from the 2300 shaft station will be driven by a suitable blower through common ventilating pipe into the winze. As to the quantity of ventilating air to be so delivered it will be held subject to your measurement as the blowing plant is now in operation and I, myself, have no time for interesting but unprofitable pursuits.

Questions 18 *and* 19. As to the future ventilation of the mines, etc. Subject of disposal of air from the winze answered on p. 23.

As to general system of ventilation, the executive of the Pumping Association has no authority. You are respectfully referred for

information to a council of the North End Superintendents who can alone determine such questions.

Question 20. As to pumping elsewhere than at the Con-Virginia winze, is answered under topic, "Choice of Winzes," pp. 11 et seq. as far as the 2700 level is concerned. If you refer also to plans for unwatering still lower levels, these will depend upon our financial condition, upon the results of our mine development work and upon such policies as may be determined by the Association Board for my guidance.

Question 21. As to the condition of the Con-Virginia winze, is answered in note on p. 11.

Question 22. As to the number of men to be used in lowering the water, is answered on p. 23.

Question 23. As to method of handling debris encountered in sinking is answered on p. 22.

Question 24. As to suction screens and cleaning of same. Answer: We will use the standard screen for the pump, as recommended and supplied by the manufacturers of the pump. As to cleaning these screens when the pumps are in position at the bottom of the winze, this will be done, as usual in such cases, by rakes and brushes on handles appropriately shaped for reaching the screens. Sinking operations will frequently expose the screens.

Question 25. As to sizes and hanging of pipe is answered on p. 22, as to method of suspension and size of discharge column; and p. 24 as to size of air pipes. Ventilating pipes will be hung in manway by suitable clamps as in standard practice.

Question 26. As to men selected to carry out the winze work, is answered on p. 23.

Question 27. As to present storage room for water on 2000 level station. Answer: I have the upper and lower tanks which were a part of the installation when I took charge.

Question 28. As to new water storage on the 2000 level. Answer: The present storage capacity is expected to be sufficient.

Question 29. As to new water storage elsewhere than on the 2000 level. Answer: No new storage is planned.

Question 30. As to reports made by me. Answer: As is well known, I have made written reports weekly; and they have been published. I have made no special report on the use of the Starrett pump, but have at all times counselled with the president and other members of the Pumping Association who were sufficiently inter-

ested to permit it. I have quoted in full my report of July 1, 1913, on changes made by me in the pumping plant and organization.

Questions 31, 32, 33, 34, 35, 36, 37 *and* 38. As to my operations in cleaning out and repairing the old 2500 level. Answer: Work in the 2500 level east crosscut required 49 working days, 372 man shifts, costing $1506.92, being charged to it, or a total labor cost of $2.667 per foot through a distance of 565 feet. Two new tunnel sets and nine new posts were used and many of the old sets were found distorted so that they had to be taken down and set up again. New lagging was put in at various points and new spreaders, floor and track were placed through the entire distance. Ten sets of spiling were driven. Muck was found standing in the crosscut to a depth of several feet through most of the distance and sometimes it entirely filled the crosscut, though occasional spaces were encountered in which there was little muck. The whole crosscut work produced 899 cars of muck.

Similar conditions were found in the North Drift, which was opened 455 feet in 56 working days, 674-5/8 man shifts, costing $2885.75, being charged to it. It required 13 sets of timbers, and new spreaders, floor and track for the entire distance; but there was no spiling. Six hundred and eighteen cars of muck were taken from it.

In repairing the Con-Virginia winze station 901½ man shifts, costing $2608.50, were charged in 55 working days to the beginning of this month, 1001 cars of muck being produced from this work.

The above fully answers every point raised in the questions enumerated except as to the depth at which the muck stood at all points. Naturally no one would keep such data unless he anticipated the necessity of answering such questions. The statement of cars of muck is inserted, however, as our nearest data bearing upon the subject.

Question 39. In regard to decrease in consumption of power. Answer: As the pumping plant is unchanged from its condition when it came into my charge, excepting only the elimination of the air lift at the 2000 level, no material reduction in power should be expected. The elimination of about 40 horse-power due to that change should easily be balanced by the notorious drop in efficiency which occurs in turbine pumps after they have been subjected to even moderate wear. Nevertheless, I will present such data as appears to bear upon the subject.

The following table shows the total of monthly power bills of the Association from October, 1912, to September, 1913, and also the horse-power consumed in pumping only:

Month 1912		Power Bill		Horse-power of pumps segregated from total power
October		$5,791.00		996
November		5,447.00		957
December		(5,826.00		(1041
1913	Average	(	Average	(
January		(6,147.00		(1097
	$6,057.00	(	1085	(
February		(6,200.00		(1117

Though my appointment was dated January 25th, I was not in a position to do much more than study conditions for several weeks and the existing system was allowed to take its course through February.

March		($6,126.00		(1092
		(		(
April		(6,039.00		(1072
		(		(
May		(5,838.00		(1034
	Average	(	Average	(
June		(6,053.00		(1077
	$5,938.00	(	1052.	(
July		(5,584.00		(992
		(		(
August		(6,051.00		(1064
		(		(
September		(5,852.00		(1033

It here appears that from the first month in which the turbine pumps were operated there was a distinct increase through February, both in the actual horse-power for pumping and in the total of our power bills; second, that, comparing the average horse-power and total power bills of December, January and February, when the wear on the pumps may be considered to have commenced to have effect, with the average of all subsequent months, it is seen that the one has dropped from $6,057 to $5,938 and the other from 1085 horse-power to 1052 horse-power in spite of the decrease in efficiency from wear noted above.

Question 40. As to repairs to Riedler pumps. Answer: Permanent records as to the nature of such repairs are not kept, as they would be interesting but of small value. Upon these repairs as a whole, however, we have expended 519¾ man shifts, costing $2,-578.24 for labor; while materials used in the work have cost $579.44.

The total cost of Riedler repairs, even with a highly efficient mechanical crew, has thus amounted to $3,157.68.

Question 41. As to decrease in number of men employed on pumps. Answer: Decrease of three men on the 2500 pumps made possible by the start of mining work on that level.

Question 42. As to decrease in number of men employed on hoists, etc. Answer: These men are employed by Con-Virginia, and I have no authority over them.

Question 43. As to decreases in machinists and electricians. Answered on p. 7 as to machinists. In regard to electricians, I found four employed more or less industriously, but soon learned that the chief electrician alone was capable of doing all the work required.

Question 44. As to machinists dispensed with, is answered on p. 7.

Question 45. As to other decreases in the men employed. Answer: One tank watchman has been laid off. As to the means by which we have been able to dispense with him, a discussion doing the subject justice is beyond me.

Question 46. As to purchases of material by the Pumping Association. Answer: This question as stated can have no possible bearing upon the subjects of your investigation, as any materials which have been purchased have been either charged out by the storeroom as a cost to my various operations or to various mines who are our customers, or else they remain as a part of materials on hand. Materials actually consumed or used by the Pumping Association in its own work are detailed on our monthly cost sheets of operation, which are open to your inspection.

Question 47. You may take copies of the monthly financial statements as requested; but please be advised that those do not show my costs; and my monthly cost sheets of operations are the only records which clearly do this. The monthly financial statements, for instance, often include the disbursement of money for bills incurred by my predecessor and for materials in stock but not as yet chargeable to any work as costs.

In conclusion I wish to advise you of information coming to me from many sources to the effect that, since your authorization as the engineer of the Mexican Company for examining my administration and pumping project, you have repeatedly expressed yourself concerning the subjects of your examination in a spirit of frank and bitter condemnation, though, as yet, you have seen neither my works nor my records. So gross a violation of professional ethics in a shameless prejudgment, is a thing you can doubtless reconcile to your conscience. However it is obvious that your 47 questions fully cover my past administration and my future plans, which constitutes the authorized subjects of your examination. Though I have considered some of these questions to be frivolous, impertinent, un-

professional and ungentlemanly, and their whole tendency controversial and unfair, I have, as a matter of duty and loyalty to my employers, studied them with the utmost seriousness, and, at a great cost of time and effort, when I had neither to spare, have answered them fully.

I must now also answer the postscript to your letter, which indicates an intent on your part to attempt an indefinite prolongation of this examination, by further questions, into a controversy, for which I have neither time nor inclination. I must, therefore, say that, being at present under a severe strain in the execution of my important duties at a critical time for the success of my administration, I must hereafter consider this subject as closed.

Very truly yours,

A. M. Walsh.

APPENDIX I.

The Forty-Seven Questions Propounded by Mr. Symmes.

1. Have you ever seen a Starrett pump in operation and tested the efficiency of one, and if so, where; and what were the data in regard to the lift, capacity per minute, air consumption, air pressure and horse-power delivered to the compressor? If you are not relying upon your own experience in regard to the practicability and efficiency of the Starrett pump, upon whose recommendation are you relying?

2. What mines that you know of are now using Starrett pumps and what are the data in regard to the lift. capacity, air consumption and power consumption at the compressor, at these mines, and who is it that vouches for the data that has been supplied to you?

3. How many Starrett pumps do you intend to use in the Con-Virginia 2500 level winze, and what is the manufacturer's rated capacity and what is the capacity of each of the displacement chambers of the said pumps?

4. What method do you propose to use in installing said pumps and lowering the water in said winze?

5. To what point below the collar of the winze do you expect to lower the water?

6. What quantity of water per minute do you calculate is now coming in on the 2500 level to the C. & C. Shaft, and how much is coming up the Con-Virginia Winze, and what additional quantity of water per minute are you allowing for in order to drain the ground between the collar of the winze and the said point to which you expect to lower the water?

7. How many cubic feet of free air per minute, measured at the collar of the shaft (compressor displacement measurement) do you expect to use when beginning pumping operations, and what quantity of compressed air do you expect to use when holding the water at the said point to which you expect to lower it?

8. Of the total quantities of air used in operating the Starrett pumps, what quantity do you expect to use in the displacement chambers of the pump, and what quantities in the discharge column?

9. What size or sizes of compressed air pipe do you propose to use in bringing air from the compressors to the Con-Virginia winze, and will this line be connected with the compressed air lines to the Con-Virginia and Ophir mines?

10. What pressure of air do you expect to have at the compressors and what pressure do you expect to deliver to the pumps when beginning pumping operations?

11. What pressure do you propose to use at the compressors and what pressure do you propose to use at the pumps when the water has been lowered to the point to which you propose to lower it?

12. What quantity of air (compressor displacement measurement) do you propose to use in operating the air lift between the 2000 station tanks?

13. What compressors do you propose to use in the work of lowering the water and supplying the compressed air to the mines, at what speeds do you propose to run them, and what will be their total (displacement) capacity in cubic feet per minute?

14. What average electrical horse-power do you expect to use in operating each of these compressors, and if they are to supply air to the mines also, what quantity of air do you allow for the use of the mines?

15. Do you propose to have any sump, or sump room at the point to which you intend to lower the water, and if so, please describe the same?

16. What will be your modus operandi in making repairs upon the pumps, and what provisions have you planned for holding the water level while doing so?

17. What means of ventilation and what quantity of air do you propose to supply for the men working on the pumps, and doing other work in the Con-Virginia 2500 level winze?

18. How do you propose to divide the air used for ventilation at the north end after the Starrett pumps are put into operation, how much air will be led through the 2500 east crosscut from the C. & C. Shaft, and through what workings will the air be led to ventilate the workings in the Con-Virginia and Ophir mines on the 2500 level and below?

19. What means do you propose to use for carrying off that hot air and steam from the Con-Virginia winze, and what will be the system of ventilation as to down-casts, up-casts and the direction of air currents upon the 2500 level?

20. Do you propose to do any work in regard to the pumping and the lowering of the water level at other points than at the Con-Virginia 2500 level winze, and if so, kindly give me details of same?

21. Have you determined the condition of the Con-Virginia 2500 level winze, and what are the details in regard to the same?

22. How many men do you propose to use in operating and lowering the Starrett pumps while lowering the water level and how many men in operating the pumps after the water has been lowered to the point to which you expect to lower it?

23. How do you propose to handle the debris encountered while lowering the water level?

24. What screens or other devices do you propose to use in protecting the suction of the Starrett pumps, and what method do you propose to use in cleaning the same?

25. How do you propose to hang the compressed air pipes, auxiliary pipes and discharge columns in the 2500 level winze and what size pipes do you propose to employ?

26. Have you selected any men whom you consider especially competent to carry out the work in the Con-Virginia winze, and if so, kindly state their names and their particular work to which you expect to assign them.

27. What provisions have you now got for water storage at the 2000 level pump station, and of what capacity?

28. How much water storage do you calculate you require on the 2000 level while unwatering the ground below the 2500 level, and explain in detail how you plan to obtain this storage.

29. Do you plan to construct more water storage at any other point than where the storage is now provided? If so, state details of the same.

30. Have you made any written reports to the Pumping Association or its president in regard to the use of the Starrett pumps for lowering the water in the Con-Virginia 2500 level winze, or in regard to any change in the pumping plant made by you since you took charge of the same? If so, may I take copies of the same?

31. At what points did you find the 2500 level east crosscut from the C. & C. Shaft to the Con-Virginia winze, to be caved and for approximately what length in each place was it caved, and to apparently what height above the floor of the drift did the muck stand?

32. At what points did you find the northwest drift from the Con-Virginia 2500 level winze, to be caved, for approximately what length at each point was it caved and to what height did the muck stand in the drift at each point?

33. How many new tunnel sets have you placed in the 2500 level east crosscut, and how many new tunnel sets have you placed in the northwest drift from the 2500 level winze station?

34. How many sets of spilings did you drive in the said crosscut and how many did you drive in the said drift?

35. State the number of men and shifts you have had at work cleaning out the east crosscut from the C. & C. Shaft, and the total

number of shifts which they put in up to the time when they reached the Con-Virginia winze.

36. State the number of men and the total number of shifts employed in cleaning up the northwest drift from the Con-Virginia winze.

37. What length of the said northwest drift have you cleaned up or put in repair?

38. How many men have you employed and what is the total number of shifts that they worked in cleaning up and retimbering the Con-Virginia 2500 level winze station?

39. How much if any, have you decreased the consumption of power for pumping at the C. & C. Shaft since you took charge of the pumping operations there, and state the electric motor readings and electric power bills which will show this decrease.

40. What repairs have you made to the Riedler pumps since taking charge of pumping operations and state the number of shifts employed in making these repairs, and the total cost of the work?

41. Have you decreased the number of men employed underground in operating the pumps below the number when you took charge of pumping operations? At what points and at what times did the decreases take place, and by what means were you able to get along with less number of men?

42. Have you decreased the number of men employed on the surface in the operation of hoists, boilers and air compressors, at what times and by what means?

43. To what extent have you decreased the number of machinists and electricians employed by the Pumping Association, at what time did the decrease take place, and by what means were you able to get along with fewer men?

44. How many machinists were you able to dispense with when you had completed the repairs to the Reidler pumps, which repairs were under way when you took charge?

45. What other decreases have you made in the number of men employed by the Pumping Association and by what means were you able to get along with fewer men?

46. What mine timbers, plant or equipment of any description for use on the surface or underground have you purchased for the Pumping Association since you took charge of it?

47. Will you allow me to send someone to the Pumping Association's office to take copies of the Association's monthly financial statements?

APPENDIX II.

Cost of Temporary Pumping Installation—E. & O. E.

The books of the Pumping Association show the following costs for the purchase and installation of the temporary pumping plant, consisting of the 2310 horizontal electrical turbines, with station for the same, the vertical electrical turbine sinker pumps at the 2500 level of the C. & C. Shaft, the extra turbine sinkers purchased for the Ophir-Mexican winze, transformers, cable and accessories.

Cutting 2310 Station.

Labor		$ 4,072.61
Supplies:		
Ice	389.75	
Powder	156.75	
Lumber	892.04	
Steel	193.57	
Cement	117.58	
Sundries	596.11	2,345.80
Total cost cutting station		$ 6,418.41

Installing 2310 Pumps.

Labor		$10,518.17	
Supplies:			
Bolts	129.56		
Pipe	472.50		
Valves	156.50		
Fittings	313.80		
Lumber	382.00		
Steel	111.67		
Ice	349.79		
Packing	132.45		
Cable	122.00		
Sundries	546.71		2,854.97
Charging Oil Switches			580.28
Testing Pumps			275.00
Total			14,228.42

Installing 2500 Pumps.

Labor		$ 8,179.59
Supplies from stock		3,799.45
		$11,979.04

Equipment Charges to Temporary Plant.

Vertical turbine pumps		$12,940.00
Horizontal turbine pumps		6,225.00
Motors		11,366.09
Transformers		2,431.03
Electric Cable		7,254.04
Freight		2,770.78
Flanges	1,005.11	
	199.35	1,204.46
Switches		501.39
Bronze Rods		231.87
Castings		483.04
Expansion Joints		616.00
Pump parts		580.50
Coils		489.22
Tank		163.55
		$47,256.97

Summary:

Cutting 2310 station	$ 6,418.41
Installing 2310 Pumps	14,228.42
Installing 2500 Pumps	11,979.04
Cost of equipment	47,256.97
Total cost of temporary plant	79,882.84

It is estimated that for such a sum hydraulically operated plunger pumps of great efficiency and peculiarly applicable to Comstock conditions could have been installed on the 2500 level, and they would have done the work not only of the temporary plant, but of the Riedler pumps as well. They would have been operated at such a reduced cost for power that this saving would have paid for them in less than a year; and their ability to operate under water would have been worth

many thousands of dollars to the Lode as insurance against loss of pumps by rises of water. As stated in the body of this report they could have been installed without the previous purchase of the temporary plant.

Lest exception should be taken to my having included in the cost of the temporary pumping plant the equipment designed for the Ophir-Mexican winze, it may be stated that this equipment, including two pumps, two motors and three transformers, cost about $10,235, which would leave $69,647.34 as chargeable without dispute. However, it should be observed that these purchases were made as one and that the net benefit we have derived from the expenditure they involved, amounts simply to the possession of the temporary plant plus two pumps, two motors and three transformers, for which we have no use, and we know of no market for the pumps and motors.